symmetry is either parallel or perpendicular to the plane of polarisation of the light (the analyser being crossed), a few broad, black, curved bands crossing the main black band lying in the plane of symmetry, which are probably portions of the isochromatic curves of a very thin plate. But, on the other hand, some non-iridescent crystals show these bands, and some iridescent crystals do not show them at all. Also the iridescent crystals which reflect D light at moderate incidences show very perfectly the circular band described by Prof. Stokes (NATURE for April 16, 1885, p. 566, par. 9) as sharp black crescents, the horns of which nearly touch each other at the plane of symmetry.

Almost the whole of the ordinary commercial crystallised potassium chlorate seems to consist of macles; so that, in order to get a single individual crystal for examination, I have always had to cut away one component of a twin.

It seemed worth while to try whether other biaxial crystals would, when similarly combined, give similar phenomena. I took a crystal of barite (barium sulphate), the angle included by the optic axes of which is, according to Groth, 63° in air, and cut a plate of it in such a direction that the plane containing the optic axes made an angle of 53° with the normal to the surfaces of the plate. I then cut it in half and cemented one of the portions upon the other in a reversed position. The compound plate thus produced shows the secondary ellipses (which, however, are very nearly circles) in great perfection. I have also made similar compound plates of borax, nitre, and citric acid, and found them to give similar results. H. G. MADAN

Eton College, August 24

The August Meteors

BETWEEN August 4 and 20, 174 shooting stars were recorded here in $16\frac{1}{2}$ hours of observation. These included about 37 Perseids, chiefly seen on August 5, 8, and 13, but the shower was not well observed owing to cloudy weather. The following are the chief radiant points determined from the paths registered :—

No.	Epoch August	Radiant		Notes
		α °	δ °	
1	16–20	5	+12	Meteors bright, max. Aug. 20.
2	13	51	+58	Perseids.
3	4-17	292	+52	Near χ Cygni.
4	5–13	296	±0	On equator near η Aquilæ.
5	5–20	317	+22	Meteors slow and faint.
6	8-17	318	−9	Slow, S.W. of β Aquarii.
7	15–17	328	+27	Slow, faint.
8	11–15	329	+8	Slow, bright, E. of ε Pegasi.
9	16–20	345	±0	Rather swift, bright.
10	8–20	345	+53	Very swift, short.
11	16–20	351	+38	Swift, E. of ο Andromedæ.

Many other shower centres were less distinctly shown. Nos. 4 and 9 fall exactly on the equator, and were sharply defined.

As to the shower of Perseids on August 10, I believe it was more brilliant than usual, though I made no regular observations on that night this year in consequence of overcast sky. Many meteors were, however, noticed in the clear spaces which now and then occurred, and judging from the frequency of the apparitions the display was a fine one. As to the duration of the shower it was still visible, though very feebly, on August 20, for I registered 2 undoubted Perseids during a watch of $3\frac{1}{4}$ hours, when 31 meteors were recorded.

With regard to the minor displays of this epoch they are more remarkable for their number than for individual intensity. The most active of these radiants, as recently observed, was No. 10 at $345^\circ+53^\circ$, which supplied about 10 meteors, but the rate was less than one per hour, so that it cannot be ascribed much importance. W. F. DENNING

Bristol, August 25

Disinfection of Sewers

IN the last number of the *Lancet* (August 15, 1885) I have read of the measures taken by the Metropolitan Board of Works for the deodorising and disinfecting of London sewers. Between 30,000 to 40,000 tons of sodium manganate and from 10,000 to 12,000 tons of sulphuric acid are daily poured in the London sewers.

By what experiments has it been ascertained that the quantities of disinfectants used are sufficient, and how is it proved that the sewers have been properly disinfected?

I need not point out the difference between the deodorising and the disinfecting of sewage. The latter may be perfectly deodorised, and yet be quite adapted to favour the vegetation of bacteria.

The oxidising and deodorising action of sodium manganate cannot be sufficient to prevent bacterial life, unless when the salt is present in large quantities. Considering the enormous volume of London sewage, it is not to be believed that even such a vast amount of manganate as 40,000 tons *per diem* would suffice to destroy bacterial life in the sewers.

The adding of sulphuric acid to the manganate must certainly enhance the disinfecting action of the latter. Only, I do not understand why the quantity of sulphuric acid is relatively so small in comparison with the quantity of manganate. I do not see why manganate should be used at all when sulphuric acid, a more powerful and less costly disinfectant, can be used alone.

It is well known to all who occupy themselves with the cultivation and study of bacteria that these micro-organisms do not grow well in acid media, and that the addition of acids, especially of mineral acids, checks their growth completely.

It can be said that the antiseptic action of acids is of household knowledge, for vinegar is constantly used in the preservation of animal and vegetable products. That mineral acids have a greater disinfecting action than vegetable acids is also well known, unfortunately even by dealers in vinegar, who give durability to this condiment by the addition of a tiny proportion of sulphuric acid.

It is probable that pathogenic bacteria, even more than the bacteria of ordinary fermentations and of putrefaction, are in need of alkaline media, and therefore are more sensitive to the action of acids. In the animal body bacteria invade those fluids and tissues where the alkaline reaction prevails; and it is proved that the germs of disease are easily spread by milk, a liquid generally alkaline. Moreover, it has been proved by experiments on some pathogenic bacteria that gastric juice, although of so slight acidity, easily, and sometimes effectively, checks their development.

Sewage contains all the elements necessary for the nourishment of bacteria, and its alkaline reaction renders it very favourable to their growth and preservation. Disinfection means the destruction of existing bacteria and preventing the development of newly-sown bacterial germs. Therefore I am persuaded that the cheapest and more simple method for effectively disinfecting sewage is to render its reaction *permanently acid* by the addition of a sufficient quantity of mineral acid.

There are of course disinfectants far superior to mineral acids in antibacterial energy. But they are generally costly substances, that cannot be applied to the disinfection of such an enormous quantity of matter as the sewage of a town. As for cheap disinfectants, such as ferrous sulphate, ferric chloride, sodium manganate, their action is inferior to that of mineral acids. Especially of the two former it can be said that their deodorising action is due to their saline constitution, and their disinfecting action to their acid reaction.

The great difficulty in extensive disinfections is to ascertain if the disinfection has been complete—*i.e.* if the substance disinfected has been rendered unfit for the development and preservation of bacteria. Even laboratory experiments, to ascertain the *minimum* of disinfectants necessary for the destroying of bacteria, are not easily conclusive. But, in using acids, the disinfection can be considered complete when a permanent acid reaction is obtained.

I do not believe the quantities of sulphuric acid poured in the London sewers sufficient to give a permanent acid reaction to the sewage. Disinfection must be done completely, or not at all: there are no half measures in disinfection. Therefore I maintain that the London disinfection is useless, and the sewage remains likely to become the culture fluid of infectious germs, unless the sewage is rendered permanently acid. All the sodium manganate added to a sewage that remains alkaline, gets decomposed; the manganese precipitates as sulphide, or is deposited in combination or mixture with the organic sediment. The sewage will thus be cleared and deodorised for a while; but it still contains in solution all the elements necessary for the nourishment of Bacteria, and is still favourable to their growth and preservation. The disinfecting action of sodium manganate would avail only if large quantities of the salt remained dissolved in the sewage, over and above of the quantities decomposed in deodorising and clearing the putrid fluid.

It might be objected that, even if mineral acids stop the

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development of bacteria—a point that cannot be doubted—they may not kill the spores, thus permitting the germs of disease to escape. There are no experiments (of which I am aware) to answer this objection. But there is reason to believe that pathogenic germs do not resist for a very long time when in unfavourable media; even in sewers, that are not over-filled and stagnant, and that are well ventilated, infection does not easily linger. If inside the sewers disinfection is complete, and bacterial growth checked, and all disease germs rendered inactive, until carried for away from all populous centres, I think we can leave it to air, and to the other natural agents, to ultimately destroy the surviving germs, or completely alternate their pathogenic qualities.

Amongst the mineral acids, hydrochloric would, of course, be the cheapest. But I think sulphuric acid ought to be preferred, nitric acid being too costly and too corrosive. Sulphuric acid does not attack easily calcareous cements; and if the sewers have their walls well plastered, the action of a *slight excess* of sulphuric acid in the sewage would be very slight indeed. Cements, more resisting than plaster, could be prepared. Moreover, if some portions of teh sulphuric sewage get carried in the air, or are dried in the higher parts of the sewers, the germ-laden particles do not rid themselves of the acid by evaporation; on the contrary, the acid becomes more concentrated and active, and finally must disorganise and destroy the noxious germs. This is very important in preventing the effects of sewage air.

Since 1881 Prof. Beilstein of St. Petersburg (NATURE, vol. xxiii. p. 394), experimentally concluded that sulphuric acid is the best disinfectant, although he did not advise its use because of its corrosive action. Strange to say, Beilstein thought that, practically, aluminous sulphate was to be preferred to the free acid.

It is not only during the fear of cholera invasions, but at all times, that I would wish the sewage to be *slightly* acidified with sulphuric acid. Strict supervision should be maintained over all the sewers, to ascertain that the whole mass of flowing sewage is permanently acid. I am persuaded that this simple mode of disinfection would diminish considerably many infectious diseases.

During the cholera epidemic of 1884, in Naples, I did my best, in a series of letters I then published, to persuade the sanitary authorities of this mode of disinfection. But a strange confusion of ideas was then prevalent in Naples. Through the goodwill of Prof. Cantani, Member of the Sanitary Commission, some trials of the method I proposed were done, but not in a complete and systematic manner. Such experiments cannot be done easily in Naples, and the results cannot be conclusive until the system of sewers is in good working order. Indeed, in some parts of the soil of Naples it is difficult to know if there is more sewage inside or outside the sewers. It is no easy problem to disinfect and cleanse such an impure soil, and it is indeed to be wondered that the ravages of cholera were so limited in 1884.

My letters caused sulphuric acid to be used abundantly in the sewers and *pozzi neri* of Portici, Castellamare, Taranto, and, I believe, in other places; but this, like all other disinfections, was done under pressure of approaching cholera, and abandoned as soon as the danger passed, no observation being made to measure the influence of the sanitary method adopted on local infectious diseases. The defective system of sewers and of drainage in many Italian towns renders thorough disinfection scarcely possible, and prevents precision in testing any kind of disinfection.

In English towns sewers are generally well arranged, and often well ventilated; and vital statistics have taken sufficient development to permit the testing of sanitary reforms. When it is proved (and I think the proof can be easily given) that the present systems of sewage disinfection are not sufficient to prevent *entirely* bacterial development in the sewers, these systems cannot be considered good. I venture to hope that beneficial results would soon become evident if the sulphuric acid disinfection of sewage were thoroughly applied in English towns.

Portici, August 20 ITALO GIGLIOLI

Ozone at Sea

THE presence of this element in the atmosphere is alleged to be indicative of its healthiness, and it has been *investigated on land* frequently by observers with varying and uncertain results.

Records of its presence may be seen daily in the *Times*, furnished from the Observatory on Ben Nevis, but as yet little notice has been taken of its *prevalence at sea*, though it has been supposed to be more plentiful there than on land.

During a voyage around the United Kingdom on the s.s. *Ceylon* in August last, we entered into the investigation of its existence at sea, and used Moffatt's papers for the purpose, obtained from Negretti and Zambra. They were exposed in a perforated light wooden box, hung up in the open air on the deck of the ship in the shade, and noted and changed twice a day.

It was found most prevalent in *Cork Harbour* (4), less so in Bantry Bay (2) and Oban Harbour (2), and nearly absent in Kingstown Harbour (1) and Leith Roads (1).

In the open sea it was most shown in the *Irish Channel* (4) and off the Lands End (4); next in the North Seas (3) and in the English Channel (2), and least in the Irish seas (1) and western coasts of Scotland (1).

Ozone was found to be indicated in greater intensity during the prevalence of *westerly winds* in the English and Irish Channels, and Atlantic seas and Dutch seas, and less with *easterly* winds prevailing in the Irish seas, Firth of Forth, and west coasts of Scotland.

The *velocity* of the winds seemed also to create a higher manifestation, as was seen during the gale from the south-west in Cork Harbour and the fresh north-westerly breezes on the south coasts of Ireland and east coasts of England. None, however, of the observations approached those registered in the *Times* from Ben Nevis (8–9), which amounted to double those noticed in the seas around our coasts during the same period (August), supposing that the same papers and scale (Moffatt's) were used for both sets of observations.

Ozone was also found to exist in the *cabin of the ship* both day and night, but at a half intensity to that on the deck, due probably to the great difference in the movement of the air in the two places.

The degrees of manifestation of ozone at sea here shown by no means come up *to expectation* that it prevailed in all its potentiality on the ocean, but of course a whole year's observation would be required to enlighten the subject and furnish a comparison with that on the land.

Again, it may be possible that *altitude* may have something to do with its prevalence, more or less, as it appeared more on the top of Ben Nevis than on the level of the seas of the same coasts near it and at the same period of the year (August).

Should this idea be of any significance it might be as well to search for manifestations of ozone at the base as well as on the top of mountains, and if similar results followed to these here pointed out it would establish the *reputation of high* level sites for great salubrity of atmosphere. W. J. BLACK

August, 1885

THE INTERNATIONAL BOTANICAL AND HORTICULTURAL CONGRESS, ANTWERP, 1885

THE International Botanical and Horticultural Congress met at Antwerp on Sunday, August 2, in the hall of the Artistic, Literary and Scientific Club, the opening meeting being honoured by the presence of a good many ladies. The gathering was a representative one, and included many well-known European botanists and horticulturists. The Burgomaster of Antwerp opened the proceedings with a few appropriate remarks, and Prof. Ed. Morren, of Liége, having been made President of the Congress, took the chair, and a discussion was held on the flora of the Congo. After a short discussion the meeting adjourned to the Exhibition building, where the International Horticultural Show was being held, and which was formally opened at one o'clock. Many of the plants exhibited were of great interest, and the whole of the collections were nicely and artistically arranged. At five o'clock the Congress visited the Plantin Museum, the old printing office of the Plantin Moretus family. The Museum is full of interest, and as the printing office from which the works of Lobel, Dodonaeus, and Clusius issued, doubly interesting to all botanists. Through the kindness of the Burgomaster of Antwerp a sheet had been struck off for the members of the Congress, so that each was presented with a souvenir of the three great herbalists.

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